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Section I

Accounting With the Point System

(Taylor)

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Accounting With the Point System

By

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EDITORIAL DEPARTMENT NOTE

The wide adoption of incentive plans as a method of wage payment has brought with it a number of changes in the accounting records, especially with reference to labor and productive efficiency. Our paper this time deals with the application of one of these systems of wage payment, in a plant manufacturing brass and bronze rods, copper tubing, and a great variety of forged and cast parts for the automobile, refrigerator and similar industries. The materials presented show how the system is tied in with the cost accounting.

Mr. Robert W. Peden, the author of this paper, is a native of Canada, but at an early age moved to Youngstown, Ohio. Following his graduation from Hiram College of that State he took his Masters Degree at Columbia University. His first industrial connection was with the William Todd Company of Youngstown, Ohio. as Cost Accountant and System Works Manager. Following this experience he went into the teaching field and in 1919 became a Cost Accountant for the Wright-Martin Aircraft Corp. Following a year of professional work in New York City he went into the employment of the Mueller Brass Company in 1921 as Comptroller, being made Treasurer in 1927 which position he now holds. He has been a member of our Association since 1921 and has served on the Detroit Chapter Board. His paper was delivered at a very successful plant visitation meeting held by the Detroit Chapter at the Mueller Brass Plant in Port Huron, Michigan, and at a later meeting of the Buffalo Chapter.

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NATIONAL ASSOCIATION OF
COST ACCOUNTANTS

May 15, 1931

ACCOUNTING WITH THE POINT SYSTEM

IN CONTRAST with the crude approximations that served as measures in primitive times practically every major branch of modern science has its standards which have been created to assist in the measurement, classification and interpretation of the phenomena of its particular field. In chemistry we have valence, which is a theoretical device to measure the facts of the realm of matter. In astronomy we have the light year, a standard for the determination of distances from star to star. In electrical engineering we have the volt, the ohm, and the ampere. In thermodynamics we have the calorie and the B. T. U. or British thermal unit. In mechanical engineering we have the horsepower, a purely arbitrary standard which enables the power engineer to measure the expenditure of energy in combusion, in radiation, in fraction, and in effective mechanical work.

If we have the intellectual discernment we can see that all of the foregoing scientific measures are characterized by three features: (1) They are *convenient,* in that they correspond to the average unit of data to be measured; (2) They are *exact* to the highest degree; (3) They provide a common denominator, thereby giving us a complete universality of application.

With this general conception of the modern trend toward more exact and definite standards in all of the branches of the physical sciences, therefore, I propose to discuss first, the B as a standard for the measurement of human labor; secondly, the practical application and use which we as a company have made of that standard; and thirdly, the means we have employed to use the B in our cost accounting system.

I.

"The B is a fraction of a minute of work, plus a fraction of a minute of rest, always aggregating unity, but varying in proportions to the nature of the strain". Dr. Frederick Taylor recognized this principle when, in the yards of the Bethlehem Steel Company a number of years ago, he perceived that it was necessary to alternate a cycle of work with a cycle of rest. By this method he was able to increase the production of unskilled laborers in loading pig iron from 12½ tons per man per day to 47 tons per man per day.

In its practical determination the B is the elapsed time of an

operation, modified first, by the speed rating of the operator, and secondly, by the difficulty and disagreeable nature of the task itself. Both of these qualifying factors, the speed and the fatigue are determined by scales and standards which are peculiar to each business but which our time study men are trained to use and apply.

To those of you who may challenge the possibility of obtaining mathematical exactness in computing a B value may I submit the opinion of a noted statistician, Arthur L. Bowley, who says in his book, "Elements of Statistics":

"The course of scientific measurement has generally been to take first a rough observation of a quantity, such as the distance of the sun, the thickness of a stratum, the atomic weight of an element, the specific gravity of a substance; then, as information accumulated, as the precision of instruments increased and methods were better adapted, to make the measurement gradually more and more accurate. It is important to appreciate this development, for in the present state of our knowledge, many statistical measurements cannot be made with precision for want of data, and a critic is inclined to say that for this reason preliminary estimates are valueless; but from the scientific point of view this criticism is wrong, for a faulty measurement made on logical principles is better than none, and may lead to others with progressive improvement."

Our experience is that on repetitive operations permitting numerous studies, the derived B's obtained by different time study men will not vary more than from 1% to 3% from the normal or established B value. That this is entirely possible and that accurate scientific statistics can be computed for the elusive phenomena of human behavior is borne out by the experience of the life insurance actuaries in the computation of mortality and life expectancy tables. For the two hundred individuals in this room there would be available group annuity or group life insurance figures which are deemed sufficiently accurate to permit these great companies to risk their capital under binding and non-cancellable contracts. If it is possible for the insurance actuary to determine the life expectancy for a given age with mathematical certainty, is it not

logical that the amount of work required for a given operation can be computed with equal precision and exactness?

The point system of wage payment provides first, for the establishment of standards of performance, secondly, for the payment of an incentive to the direct worker for exceeding the standard, and lastly, for the payment of a premium to supervision and indirect workers on the basis of the savings in labor costs alone. This plan differs from others in that no premium is paid to the employee for performance below standard. In this respect it

CHART NO. 1

Clock No. 12013 Name John Jones
Operation Hammer Forge

The B base rate for your operation is 60 cts. per hour. This amount is guaranteed you for every hour of the day that you work. It is paid to you for 60 Bs of work per hour or less. For 8 hours that would be 60 x 8 or 480 Bs.

For every B you make over 60 per hour you will be paid a premium. These premium Bs are worth 75 cts. per 100.

HOW TO FIGURE

1st. job—130 pcs. @ 2.0 Bs each.....	260 Bs	
2nd. job—122 " @ 1.0 Bs "	122 Bs	
3rd. job—215 " @ 1.2 Bs "	258	
Total for the day.....	640 Bs	(Add)
Base rate Bs = 8 hrs @ 60 Bs per hr.....	480 Bs	(Subtract)
Premium Bs	160	
Value of Premium Bs per 100.....	75¢	(Multiply)
Premium for day	$1.20	
Base Earnings, 8 Hr. @ 60¢.....	4.80	(Add)
Total Pay for Day	$6.00	

Note: These figures are illustrative and not actual.

differs from the Emerson and other individual plans and the Wennerlund group plan which provides that premium or bonus should begin at from 67% to 75% of standard. It differs, furthermore, from these plans and also from the standard piece work system in that only 75% of the labor savings above standard are paid to the direct worker, the remaining 25% going to the indirect workers and supervision. In this respect, therefore, it may be interpreted as being less liberal to the direct workers than other plans but more liberal to service labor, departmental supervision, and the management for their share in assisting the direct worker to attain his standard. The plan differs also in that the losses and wastes of labor are more minutely segregated than by any other plan. We all know that the enforced idleness of employees in manufacturing plants is one of the appalling wastes of modern industry. The cost of this enforced idleness due to the business cycle and the inability of management to schedule tools, materials, and machinery properly is measured under the point system and reflected as a definite financial loss which lowers the premium earnings of the employees and the profits of the company. The plan measures that great but invisible and elusive waste due to the failure of direct and indirect operators to work at the proper speed. It is an axiom of cost accounting that almost every cost is a function of time. Interest, taxes, supervision salaries, insurance, and depreciation are all wholly or partially proportional to time. Therefore, the failure of employees to attain the standard production is an important and serious loss. The reflection of such waste in detail for managerial control is one of the unique characteristics of this system.

The point system is further based upon the assignment of a definite wage rate per hour for each class of labor, these rates being determined in advance according to prevailing market prices for the various skilled trades. These rates are set for jobs and not for men. Therefore, the temporary transfer of men from one machine to another is contrary to the principles of the plan and may result in a lowering of the supervisor's premium because it may mean an *excess* cost.

On Chart No. 1 we have an illustration of the calculation of the direct workers' wage and premium. The hourly rate is guaranteed. Performance *below* standard, therefore, results in an increased

labor cost per unit of production. The value of the premium B's depends also upon the wage rate for the job. Hours spent on day work or process allowance do not earn premium; hence it is to the employee's interest to be "on the plan" and to effect a reduction of his own enforced idleness.

Supervision premium is paid from the 25% which is withheld from direct workers' premium and which would go to them under the straight piece work plan. The amount of the premium paid to the supervision is the product of the chargeable excess cost and the total B hour of the department. In other words, the premium of a foreman is determined *partly* by the speed efficiency of his organization and *partly* by his success in eliminating wastes and losses.

Indirect employees are paid according to the index figure representing the department's overall or total B hour. Each advancing level for the B hour results in a higher value for the premium B's of the department. It is, therefore, to the interest of the indirect or service employees to maintain the direct employees at the highest possible level of speed.

II.

The actual experience of our company with this and other plans of wage payment may be of interest.

Ours is a corporation employing approximately 1,000 men. In addition to the production of standard commodities such as brass and bronze rods, copper tubing, STREAMLINE fittings, etc., we manufacture a great variety of forged and cast brass and bronze fabricated parts for the automotive, refrigerator, and similar industries, according to the drawings and specifications of other manufacturers. It is to a large extent a jobbing business with a great diversification of processes and products.

Prior to 1921 part of the plant was operating on straight pay work and part on the familiar Halsey premium plan. In 1921 the direct workers in the fabricating departments were placed on the Emerson bonus plan and the indirect employees were paid on a straight day work basis. In 1924, learning of the remarkable results of the group bonus plan in the Detroit area, we decided to install such a system in our rod mill. We organized the employees of that department into a single group. We devised a system of

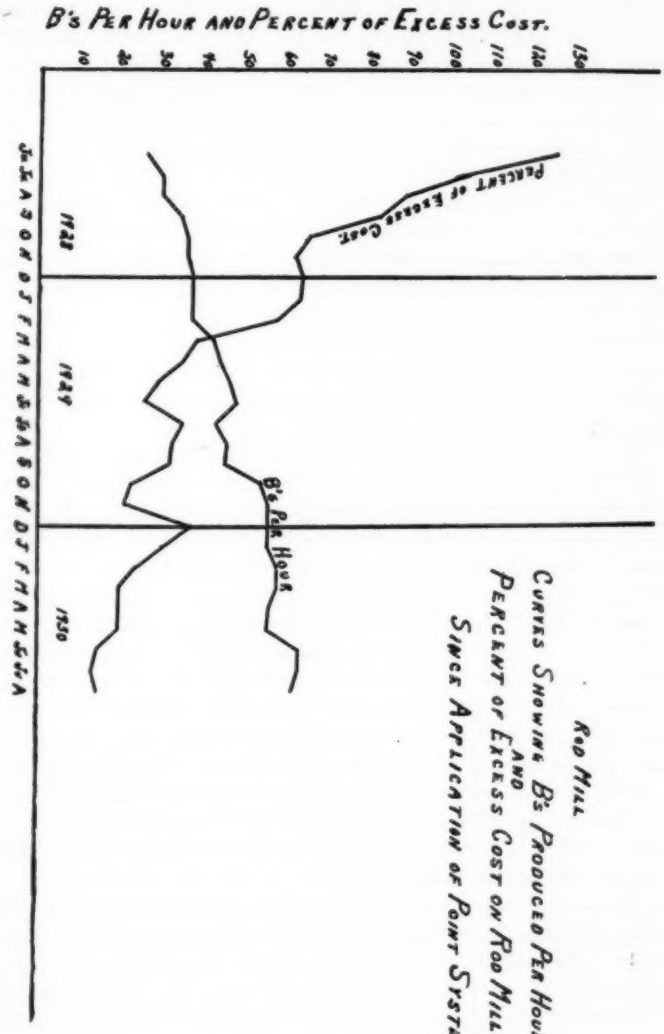
credits for the net inspected production clearing from the department, and we paid a special bonus or premium above the guaranteed hourly base rates to all employees, both direct and indirect, according to a chart representing the ratio of production to actual payroll. We reasoned that all of the one hundred odd employees of the rod mill would be vitally interested in the prospect of earning a bonus up to at least 50% of their guaranteed wages. At the beginning we experienced a gratifying gain in production. However, a few months later we became concerned about the listless attitude of individuals and we were forced to the realization that the gain which had been made was negligible in comparison with the results which we knew were possible. During this period the standard hourly production of the principal machine of the department was 19½ units per hour.

In 1925, after about a year of experimentation with the group plan we discontinued it altogether and placed all of the *direct* employees in the mill on the Emerson bonus plan, paying them a premium above their guaranteed hourly earnings, and paying the indirect employees on a straight hourly basis. Under this plan which provided a *smaller* group bonus for the gang of seven men operating the largest machine, the average hourly production was raised from 19½ to about 25 units per hour.

In the Fall of 1927 after a very detailed investigation including personal visits to several other manufacturing establishments, we undertook the installation of the point system throughout our entire plant. A comparison of the effectiveness of our original group bonus plan, our second plan of small groups, and finally our completely individualized point system can best be understood by reference to the accompanying chart, number 2, which shows the trend of the B hour and the excess labor cost from 1928 to 1930.

In a period of two years this department which had required 92 men under the group bonus was producing the same output with only 40 men. The B hour of the entire department was raised from 26 to 62; the payroll for a half month period was reduced from $6,103.09 in 1928 to $2,261.99 for a two-week period in 1930. The percentage of excess labor cost (which is the ratio of the waste labor to the standard labor) was reduced from 126% in June, 1928 to 15% in May, 1930. This means, in plain language, that under the group and other plans of wage payment in 1928 we

CHART NO. 2



ROD MILL

CURVES SHOWING B's PRODUCED PER HOUR AND PERCENT OF EXCESS COST ON ROD MILL SINCE APPLICATION OF POINT SYSTEM.

were paying $2.26 for $1.00 of effective work, whereas in May, 1930 we were paying only $1.15 for $1.00 of work. Incidentally, the average hourly earnings of all the employees of the department were raised from $0.59 per hour in June, 1928 to $0.67 per hour in 1930, an increase of 13.6%, and the principal machine which produced 19½ units per hour under the large group plan, and 25 units per hour under the plan of individual and smaller groups, has been raised to and maintained at about 40 units per hour.

How were these results obtained? This is answered by chart No. 2 which is a graph showing the progress made by our rod mill in the two years it has been operating under this plan. The gain was made by bringing *individual direct* operators up to standard; by eliminating "process allowance", which is the enforced idleness of employees due to the limitations of machinery and equipment; by avoiding lost time due to waiting for materials and stock; in short, by constant daily supervision of the *details* of the department's affairs.

The question which the proponents of the group bonus will immediately ask is—"But what does it cost you in the form of additional clerical expense to maintain this elaborate system of individual measurement?" We are business men interested primarily in profits and only secondarily in systems and methods of labor control. We, too, want to *know what it costs;* hence, when we decided to change from one system to another we decided we would record both the extra savings and the extra expenses. At the end of the first year, the gross labor savings were $188,623.88, the total additional costs in the form of *extra* time study men, *extra* clerks, and *extra* professional services were $49,451.17, and the net saving or gain was $139,172.71. These savings are computed by multiplying the difference between the percentage of excess labor costs for the period prior to the installation of the plan and the same percentage for each period under the plan by the *standard* payroll.

This leads me to offer my own conclusions regarding the claims which the different wage plans should have in our industrial order and the principles which should govern their operation.

1. There is a place in industry for group incentives; in fact, even with such an individualized plan as the point system it is

necessary to group such employees as indirect workers, a gang of two or more men operating one machine, set-up men servicing a group of machines, etc. The effectiveness of the group incentive, however, varies inversely according to the number of participants in the group and the more individualized the plan the better the results. As the brilliant English essayist, G. K. Chesterton, has epigrammatically remarked, "because one man is a biped, fifty men do not make a centipede". There is no such entity as a "group mind", whether the group be a nation, a factory, or a family. Just as the most successful systems of political economy have been built upon the solid rock of individual state rights, so I believe most strongly that a successful and efficient industrial organization must be built upon a foundation of individual effort and individual reward.

2. Any wage incentive plan, whether individual or group, which is not based upon wholesome, detailed, scientific time studies is simply a loose and dangerous form of collective bargaining. I believe that the labor efficiency of some of our great automobile plants has been very greatly over-rated and when the law of diminishing returns begins to operate in that industry with the same impersonal relentlessness with which it has operated in the steel, textile, and other older industries, the executives of our great automobile factories will find themselves resorting to more scientific and detailed forms of labor analysis and control. Nobody knows whether the B hour in the Ford Motor Company is 40, 60, or 80. What does it mean when an executive states that a group bonus has reduced his costs 20% when a scientific analysis by time study and standards might indicate that it ought to have been reduced 80%. Incidentally, does anybody in the automotive industry know what the process allowance or enforced idleness on the far-famed "assembly line" really is?

3. A third requirement—tools of scientific inquiry and research. We need some such standard as the point or B just as mechanical engineering needs the horsepower and just as electrical engineering needs the ohm and the volt. Mr. Haynes has advocated a similar unit which he calls the Manit and Mr. Alford has advocated the kilo man hour, both of which deserve the consideration of industrial executives everywhere.

CHART NO. 3

MULLER BRASS CO.
TIME STUDY SUMMARY SHEET

B Hour	B Value	Time Study No.
89	.378	15700
Base Rate .66	Unit Measured 1 Slug	

Date 8/2/28	Mach. No. 11	Operation or Element Hammer Forge 2500# Hammer	Piece No. F-4293
Operator Snyder	Department 12	Description of Product 29/32" Rd. x 13" Wt. = 42.5 Ozs. 4 Pcs/Slug	Operation No. 4
Timer T. N. T.			Material 211

Sym.	Details of Operation or Element	Shortest Actual Time-Sec.	Selected Actual Time-Sec.	Speed Factor	Effort Factor	B value
1.	Tong slug from die to wheelbarrow, oil die with swab turn to oven and tong next slug from oven to die	5.0	6.1	N+F—	1.30	.165
2.	Forge slug using three hits in blocker and two hits in finisher	6.0	6.0	NN+	1.30	.141
3.	Load one half oven as it becomes empty.....	1.75	1.8	NN—	1.40	.038
4.	Total B value from study	12.75	13.9			.344
	Plus 10% allowance for line up					.034
	Total B value per slug..					.378
5.	Std. B value from table (42.5 oz., 5 hits)					.382

Taken from Observation Sheet:

Element	1	2	3				
Speed	N+	F—	N+	N			
Effort	1.30	1.30	1.40				
Time	7.8	6.0	210	sec.	÷	120 slugs	= 1.75
	5.0	6.0	145	sec.	÷	80 "	= 1.80
	6.6	6.0					
	6.0	6.2					
	6.6	6.0					
	6.0	6.0					
	5.4	6.0					
	6.2	6.0					
	5.2	6.0					
	6.0	6.0					
Total	60.8	60.2					
Average	6.1	6.0					

Note: These figures are illustrative and not actual.

III.

Having reviewed the general theories upon which the point plan is built and its specific results in our business in the way of cost reduction, let us now trace the steps by which we have been able to use the B for cost accounting purposes.

Chart No. 3 illustrates the first step in the application of the unit, namely, the detailed time study. As the chart indicates, numerous time observations are made of each specific operation. The average or median then is recorded. This is next adjusted according to the speed factor of the operator which every time study man is trained by tests to appraise. This selected actual time is still further corrected to give credit for the proper factor for effort and fatigue. The amount of this credit depends upon the weight of the part handled, the nature of the strain, the rapidity of the cycle time, and other factors such as the disagreeable nature of the task. These computations result in the determination of a definite mathematical value for the amount of labor in a given operation. When the time studies are correctly made the mathematical expression of a B value becomes or should become as definite and as important an attribute of the part as its weight, metallurgical composition, specific gravity, volume, area, etc. The B value then becomes as useful to us as the copper content, ductility, or other quality of a part.

Chart No. 4 illustrates the next stage in the application of this system, namely, the creation of synthetic B values for standard operations. These B values have been scaled to reflect the differences in the work involved according to the three essential factors; namely—the weight of a part, the number of hits, and the number of pieces in a die.

Chart No. 5 illustrates the use of B values in the predetermination of manufacturing methods and operating costs. The operations are listed in sequence and show first the name and number of the machine; the checking medium, whether pieces, slugs, pounds, or other units; the B value for each designated unit; and lastly, the number of pieces necessary for the operator to produce per hour to attain the standard performance of 60 B's per hour, which is the premium level.

Chart No. 6 illustrates the first use of the B unit in our cost

accounting scheme. As one principle of the plan is the establishment of definite standard wage rates per hour for all operations according to the skill required and the market price for labor in the community, and as the labor cost per B is constant above standard performance, it is obvious that we have a method for the complete labor departmentalization of a plant. In most, but not all, divisions of our factory we have made this departmentalization coincide with our cost accounting classification so that each burden or cost center corresponds with a labor classification as established by the plan. The chart illustrates how we have obtained

CHART NO. 4

OPERATION: HAMMER FORGING
MACHINES COVERED: ERIE BOARD HAMMERS 1000# — 1500# — 2500#

Table Gives Total B Value per Slug—One Man Operation

Weight of Slug in Ounces	Total No. of Hits per Slug					
	2	3	4	5	6	7
5						
6						
7						
8						
9						
10						
12						
14						
16						
18						
20				.300		
25				.322		
30			.318	.342	.366	
35			.333	.358	.384	
40		.320	.347	.373	.400	.426
45			.362	.391	.418	
50			.376	.405	.434	
55				.420		
60				.433		
65						
70						
75						
80						
85						
90						
95						
100						

Note: Example given, F-4293, weighs 42.5 ozs. and 5 hits required

Table gives:	40	ozs.	5 Hits	.373 B Value
	45	ozs.	5 Hits	.391 B Value
Interpolating:	42.5	ozs.	5 Hits	.382 B Value

These figures are illustrative and not actual.

first the normal cost rates per machine hour and then the normal cost rates per B, by dividing the rates per machine hour by the number of direct B's which can normally be produced for each center. This chart also indicates the normal annual burden, the normal annual machine hours, and the normal rates per machine hour, designed to absorb all manufacturing costs. These rates are divided by the normal number of direct B's which the records of each department indicate can be produced for each cost or

Chart No. 5

Operation and Bedaux Schedule

FORGING DEPARTMENT

Customer—Blank Electric Corp. F-4293
Description—Front Wheel Cylinder Inlet Connection

Operation No.	Mach. Name	Operation	Total Bs & P. A. Per Pc.	Checking Unit	B Value per Unit	P. A. per Unit	Unit Prod. per Hour
2	Shear	Shear	.0272	Slug	.109		550
4	Hammer	Forge	.0955	Slug	.382		157
5	Trim'r	Trim	.0590	Pce.	.059		1017

Stock Size 29/32" x 13" 211 Mix Slug Wt. 42.5 Ozs. Pcs. Per Slug 4

Shear	Hammer	Press	Trimming	Grind
Size Small	Size 2500‡	No.	Size 3½	No. Touches
	No. Hits 5	Class Die	Nest No	No
	No. Imp. 4	No. Imp.	No. Imp. 2	Pcs. per Box
	Cut No	No. Mon.	Pcs. in Slug at Trim'r 4	Wt. Trimmed Pc.

Date 8/3/28 Part No. F-4293

Note: These figures are illustrative and not actual.

Chart No. 6

CALCULATION OF COST RATES PER HOUR AND PER B

Machine Center	Total Annual Burden, Based Upon Normal Operations	Total Annual Machine Hours Based Upon Normal Operations	Normal Burden or Cost Rates per Hour Including Direct Labor	Average No. of Direct Bs (Plus P. A.) Produced by Each Cent. per Machine Hour	Normal Burden or Cost Rates per B (Including Direct Labor and All Fixed and Variable Charges)
6 Hammers—2500#	54,920.00	14,850.00	3.698	65	.05689
5 Hammers—1500#	35.962.00	12,375.00	2.906	65	.04471
2 Hammers—1000#	14,943.00	4,950.00	3.019	65	.04645
1 Press—Coining	12,167.00	2,475.00	4.916	140	.03511
1 Press—Toledo	13,214.00	2,475.00	5.339	140	.03814
1 Press—Cleveland	12,022.00	2,475.00	4.898	140	.03499
1 Press—Bliss D. A.	11,756.00	2,475.00	4.749	140	.03392
1 Press—Bliss S. A.	32,289.00	7,425.00	4.349	140	.03106
1 Header	20,408.00	4,676.00	4.364	140	.03117
Trimming Press B. S. & Ch.	5,365.00	2,475.00	2.168	70	.03097
Trimming Press—Toledo #3½	42,529.00	27,225.00	1.562	70	.02231
Trimming Press—Toledo #5A	8,708.00	4,950.00	1.759	70	.02513
Large Shear	4.855.00	2,475.00	1.962	65	.03018
Small Shear	4,897.00	2,475.00	1.979	65	.03045
Band Saws	30,798.00	15.525.00	1.984	70	.02834
Grinders	12,335.00	7,425.00	1.661	70	.02373
Bench Work	3,880.00	2,750.00	1.411	70	.02016
Tinning	4,573.00	1,375.00	3.326	70	.04751
	325,621.00				

Note: These figures are illustrative and not actual

burden center. The result is a group of rates per B which we are now using in our cost department instead of rates per hour.

There is one qualification which should be emphasized regarding this departure. I refer to the fact that we do not use the B alone, but the (B + P.A.). It is obvious that the operating time of a machine represents a cost regardless of the labor of the operator. Therefore, in actual practice for cost and journal entry purposes the unit used is the B value plus the process allowance for each operation.

Chart No. 7 illustrates how we extend these B's for cost purposes. The number of B's in each operation is multiplied by the number of pieces, the result being the total number of B's produced. This figure is multiplied by a standard rate per B to cover all the cost of operation including direct labor, indirect labor, and other variable, fixed, and apportioned charges. The following charts will explain, first, the methods used to obtain these cost rates per B and, secondly, the reasons why we believe rates per B are superior to rates per hour.

Chart No. 8 is a comparison of the effect of varying rates of production upon unit costs when compiled by rates per B as against rates per hour. In the evolution of cost accounting various methods have been employed, including the differential machine rate, the super machine rate, the normal machine hour rate, and the original inaccurate method of applying a percentage to the direct labor costs. Without becoming involved here in a discussion of the merits of these particular plans, it is enough to say that most of them are based upon the assumption that a unit of time is the essential vehicle for the transference of burden from the burden center accounts to the work-in-process accounts. A close analysis of this premise will show it to be fallacious. With a standard rate per machine hour or per man hour any variations in the speed of an operator or a department will result in such wide fluctuations of manufacturing costs as to make the figures practically useless. This chart indicates that with a production of fifty pieces per hour, a cost calculated on the basis of a rate per hour gives a unit cost of .07396 whereas a production of 150 pieces per hour using the same standard or normal rate gives a cost of .02455. Now it seems obvious to us that what we need in cost accounting is not a rate per unit of time but a

rate of production so that the quantity of cost assigned to an article or a unit will be as definite, as standard, and as predetermined as its metallurgical composition or mechanical specifications. Whatever may be needed for shop control purposes it is obvious that only one kind of cost is important for sales purposes and that is a cost which becomes the basis for a price. This can be done by means of a rate per B because the B value per unit is constant and not variable. This chart illustrates the fact that regardless of the

CHART NO. 7

COST SHEET	Part No. F-4293	Prod. Order No. 8000
Customer's Name Blank Electric Corporation	Sales Order No. 55872	Date Completed 8/25/30
Description of Part Forged Elbow	Quantity Ordered 15,000	Quan. Completed 17,000

Kind of Material 12855# 29/32" Round Ext. Only Rod Mixture No. 211

Commodity Hammer Forging

	Weight Per C	Total Material Used	Cost per Lb.	Cost per C	Dept. Cost	Total Cost
Cold Metal		12009#	.0818		982.34	
Forging Scrap		5137#	.0800		98.96	
Net Metal	61.695	10762		5.064		883.38
Casting Shop Conv.... } Rod Mill Conc..... }		12009#	.0150		190.94	
Forging Shop Conv.					150.05	
Total				1.955		340.99
Total Metal and Conv.				7.019		1,224.37
Tool Costs				.302		52.66
Factory Cost				7.321		1,277.03
Selling and Adm. 25% Conversion (Do not Include Tools)				.488		85.25
Selling Cost				7.809		1,362.28
Selling Price				8.500		1,482.74
Purchased Parts						

Note: These figures are illustrative—not actual.

Operations	Pcs. Prod.	No. Men	B Value	Total B's	Cost per "B"	Total Cost
Forge or Sand Fdry.						
Set Up	3 Times	1	90	270	.0569	15.36
Shear	18081	1	.0272	492	.0305	15.01
Forge	17800	1	.0955	1700	.0569	96.73
Trim	17444	1	.0590	1029	.0223	22.95
Total						150.05

Chart No. 8

Comparison of the effect of Varying Rates of Production upon Unit Costs compiled under (A) the *Actual* or job cost method and (B) the *Standard* cost method, using rates based upon B Values.

No. of Pieces Produced Per. Hr.	B Value Per Piece	Total No. of B's Prod.	Total Cost Using a Rate Per Hour	Total Cost Using a Rate Per B
50	.382	19.100	1 hr. × 3.698 = 3.698 ÷ 50 = $.07396 each	.382 B's each × .05689 = $.02173 each
75	.382	28.650	1 hr. × 3.698 = 3.698 ÷ 75 = .04931 each	.382 B's each × .05689 = .02173 each
100	.382	38.200	1 hr. × 3.698 = 3.698 ÷ 100 = .03698 each	.382 B's each × .05689 = .02173 each
125	.382	47.750	1 hr. × 3.698 = 3.698 ÷ 125 = .02958 each	.382 B's each × .05689 = .02173 each
150	.382	57.300	1 hr. × 3.698 = 3.698 ÷ 150 = .02465 each	.382 B's each × .05689 = .02173 each
175	.382	66.850	1 hr. × 3.698 = 3.698 ÷ 175 = .02113 each	.382 B's each × .05689 = .02173 each
200	.382	76.400	1 hr. × 3.698 = 3.698 ÷ 200 = .01849 each	.382 B's each × .05689 = .02173 each
225	.382	85.950	1 hr. × 3.698 = 3.698 ÷ 225 = .01644 each	.382 B's each × .05689 = .02173 each

Note: These figures are illustrative and not actual

speed of production the unit cost of manufacturing remains the same.

If these rates per B are thus used it is obvious that the resulting costs are contingent upon the ability of a department to maintain a definite and constant B hour performance. While theoretically a B is a B, regardless of the task, we have learned that certain classes of work result in a higher average speed performance than others. We have, therefore, followed the principle of using cost rates based upon the average B hour which the direct operators have been able to maintain consistently for a period of at least 3 accounting periods of 4 weeks each.

Chart No. 9 shows the effect of using these standard rates upon the unearned burden accounts. When burden or cost is applied on the basis of a rate per hour any acceleration in the speed of production results in a lower unit cost. If such costs are used for sales purposes economies will be reflected either in the form of increased profits or in reduced prices to customers. Such costs are changeable, varying, and not trustworthy for the establishment of sound sales policies. Cost rates per B, however, are predicated upon the sound foundation, first, of normal expense figures, and, secondly, of normal operating speeds for men and machines. Any acceleration above or below standard is reflected as a gain or a loss to be cleared through the unearned burden account and not through standard costs. Furthermore, we not only see no reason for the use of rates per hour but we see no logical reason for separating direct labor costs from other costs, providing there is a departmentalization with labor centers and burden centers that coincide.

Chart No. 10 is a standard Analysis Sheet used for the calculation of supervision premium and the control of labor costs as used in this plan. The direct B hour is the average number of direct B's produced per direct man hour. The indirect B hour is the number of indirect B's produced per indirect B hour. The ratio of indirect B's to direct B's is determined by overall time studies. The total B hour is the total of direct and indirect B's divided by the total direct and indirect hours. The standard direct payroll represents the monetary value of the direct B's on the assumption that all operators attain a 60 B hour. The excess direct labor cost is the total loss due to the failure of the direct

Chart No. 9

Comparison of the Effect of Varying Rates of Production Upon the Unearned Burden Accounts

	Unearned Burden When a Rate Per Hr. is Used (Period of Four Weeks)		Unearned Burden When a Rate Per B is Used	
I When Dept. works @ 40 B's per hour				
1. Actual cost of operating center.....		3,802.16		3,802.16
2. Earned burden or cost.....	1,142 Hrs. @ 3.698 per Hr.	4,223.11	45,680 B's @ $.05689	2,598.74
3. Balance to Profit and Loss.....	Credit	(420.95)	Debit	1,203.42
II When Dept. works @ 60 B's per hour				
1. Actual cost of operating center.....		4,224.62		4,224.62
2. Earned burden or cost.....	1,142 Hrs. @ 3.698 per Hr.	4,223.11	68,500 B's @ $.05689	3,896.97
3. Balance to Profit and Loss.....	Debit	1.51	Debit	327.65
III When Dept. works @ 80 B's per hour				
1. Actual cost of operating center.....		4,647.08		4,647.08
2. Earned burden or cost.....	1,142 Hrs. @ 3.698 per Hr.	4,223.11	91,360 B's @ $.05689	5,197.47
3. Balance to Profit and Loss.....	Debit	423.97	Credit	(550.39)

Note: These figures are illustrative and not actual

Chart No. 10

Bedaux Analysis Sheet

Dept. Name—Forging Dept. No. 12

		—DIRECT LABOR—			INDIRECT LABOR			—TOTAL RESULTS—				
	Period Ending	B's	Time on Bedaux (Hours)	Direct B Hour	B's	Time on Bedaux (Hours)	In-direct B Hour	Total B's	Total Time on Bedaux (Hours)	Total B Hour	Waste and Losses	Day Work (Hrs.)
Prior to Bedaux	10-15-27	43,037	1,053	(41)	15,493	686	(23)	58,530	1,739	(34)	782	193
Average of past 6 Mo.	6-1-28	178,624	3,265.1	(55)	64,305	1,821	(35)	242,929	5,086.1	(48)	1,399.3	524.1
	12-8-28	265,596	3,908.5	68	93,530	2,388	(39)	359,126	6,296.5	(56)	1,253.0	260.7
	12-14-29	135,522	1,849.1	73	48,788	937	(52)	184,310	2,786.1	66	272.2	56.6

	Payroll	DIRECT PAYROLL			INDIRECT PAYROLL			TOTAL PAYROLL ANALYSIS					
Period Ending	% on Bedaux	Standard $	Actual $	Excess $	Standard $	Actual $	Excess $	Standard $	Actual $	Excess %	Waste and Losses $	Day Work $	Dept. Effect.
10-15-27	90	348.00	665.00	317.00	165.69	364.00	198.31	513.69	1,029.00	100	515.31	114.00	0
6-1-28	91	1,479.77	1,858.14	378.37	691.00	1,081.92	390.92	2,170.77	2,940.66	35	769.29	282.55	31
12-8-28	96	2,242.25	2,481.05	238.80	1,065.04	1,395.65	330.61	3,307.29	3,876.70	17	569.41	141.19	46
12-14-29	98	1,150.58	1,250.59	100.01	543.44	681.07	137.63	1,694.02	1,931.66	14	237.64	35.05	57

Note: These figures are actual.

operators to attain the standard performance. The percentage of excess cost is the ratio of the waste labor to the standard labor. The departmental effectiveness is an index figure indicating the overall effectiveness which is the total direct B hour corrected by the figure for the percentage of excess costs. For mangerial purposes this is important because it is possible for a department to operate at a high B hour and yet have a large excess cost in the form of process allowance, re-operation, lost time, etc.

Chart No. 11 is the detailed analysis of the waste and losses shown on Chart No. 10. The total of these losses is sub-divided to show the loss due to direct operators being below standard, the loss due to indirect operators being below standard, the loss due to process allowance or the enforced idleness of workers because of the lack of synchronization between machine time and man time, reoperation or duplicated work, and base rate excess cost or the expense resulting from the assignment of high priced men to low priced work.

Chart No. 12 which is our period profit and loss statement is the final repository of all of these detailed figures. Ours is a business with widely fluctuating raw material costs. About eighteen months ago the price of copper, which is our principal raw material, was 24¢ per pound—today it is 10¾¢ per pound. What we need to know, therefore, from our accounting data is not necessarily how much profit or loss has accrued on the basis of the cost of the acquisition of our materials but rather on the basis of the raw material prices which prevailed at the time the business was taken. For this reason we show a cost of sales with the material at standard market prices and with the manufacturing or conversion cost at the normal or average performance based upon normal rates and a B hour performance which we know can be attained continuously. The margin of manufacturing profit above these standard costs indicates, therefore, whether or not our sales price situation is on a sound basis. This gross manufacturing profit is then adjusted to give effect to each of the four following variations:

(1) The clearance of the unearned burden account which represents the over or under absorbed burden of the plant due to the ratio between the actual production and the normal production.

(2) A variance reflecting the difference between the actual cost

Chart No. 11

ANALYSIS OF WASTE AND LOSSES

Allowance to Equal Standard														
Direct		Indirect		Process Allowance		Lost Time		Reoperation		Base Rate Excess		Misc. Excess	Total	
Equiv. Hrs.	Cost	Equiv. Hours	Cost	Hours	Cost	Hours	Cost	Hours	Cost	Cost		Cost	Hours	Cost
239.5	116.97	745.5	390.91	108.1	59.92	238.7	130.46	67.6	28.35	30.33	11.27	1.08	1,399.4	769.29
68.9	35.83	882.9	330.61	104.0	58.76	159.9	88.35	37.1	19.84	29.26	6.76		1,253.0	569.41
21.4	10.90	123.8	137.63	86.8	44.22	36.0	18.34	4.2	2.14	21.80	2.09		272.2	237.12

COST PER 1,000 DIRECT B'S					BASIS FOR SUPERVISION PREMIUM							
Direct Std. $	Direct Std. $	Indirect Std. $	Indirect Actual $	Total Std. $	Total Actual $	Non-Chg. Excess $	Chg. Excess $	Chg. Excess %	Super. Effect-iveness		Operator B Hour	Period Working Hours
8.28	10.40	3.85	6.06	12.13	16.46	25.63	743.66	34	32		63	109
8.44	9.34	4.01	5.25	12.45	14.59		569.41	17	46		74	105
8.49	9.22	4.01	5.02	12.50	14.24	6.70	230.94	14	57	6.70	79	80

Note: These figures are actual.

of conversion and the standard cost used at the top part of the statement.

(3) A variance reflecting the difference between the actual cost of materials used and the standard cost employed at the top of the statement.

(4) Inventory corrections and adjustments.

The use of these variations corrects the standard cost figures so that a true net manufacturing profit is finally obtained.

This detailed profit and loss statement is supplemented by thirty separate commodity profit and loss statements which show the profitableness or unprofitableness of the different products we manufacture such as forgings, brass rod, copper tubing,

CHART NO. 12

Profit and Loss Statement
Ninth Period (July 4 to Aug. 10, 1930)

	Ninth Period		Fiscal Year to Date	
Gross Sales		691,749.55		5,671.590.17
Returned Goods	7,267.02		83.286.95	
All. and Credits	4,509.25		34,881.51	
Freight Allowed	$,426.43		60,057.62	
Cash Dis. Taken	5,244.77	22,447.47	46,742.40	224.968.48
Net Sales		669,302.08		5,446,621.69
Cost of Sales at Std.				
Metal	274,118.39		2,273,330.72	
Conversion	233,508.26	507,626.65	1,936,540.95	4.209,871.67
Mfg. Prod. above Standard		161,675.43		1,236,750.02
Percent. of Standard Mfg. Profit		24.2%		22.7%
Variations from Standard Costs:				
(1) Between Std. and Actual Metal	(11,227.30)		(132,640.01)	
(2) Between Std. and Actual Mfg.	3,422.70		22,954.67	
(3) Unearned Burden	45,671.32		367,480.22	
(4) Invent. Adjust	5,427.33	43,294.05	47,220.01	305.014.89
Net Manufacturing Profit		118,381.38		931,735.13
Percentage of Mfg. Profit		17.7%		17.1%
Commercial Expense Administrative	26,868.93		212,162.19	
Selling	26,197.21		206,858.14	
Warehousing and Ship	14,106.19	67,172.33	111,385.15	530,405.48
Operating Profit		51,209.05		401,329.65
Non-Operating Expense	20,371.28		189,780.30	
Less: (Interest on Investment Charged to Cost and Depreciation on Excess of Replacement Values Over Cost)	25,491.67	(5,120.39)	225,963.32	(36,183.02)
Net Profit		56,329.44		437,512.67
Percentage of Net Profit Before Tax		8.42%		8.03%

Note: These figures are illustrative and not actual.

STREAMLINE fittings, etc. This is illustrated by Chart No. 13.

Chart No. 14 indicates how the tabulating equipment can be utilized to reclassify the detailed profit and loss statement and the commodity profit and loss statements by sales territories and representatives.

Before concluding this paper I would like to request your indulgence to show the adaptation we have made of the thirteen period calendar. Our primary reason for adopting this calendar was to avoid the difficulties arising from split payrolls. We pay our employees on the first and third Saturdays of each accounting period of four weeks. Two payrolls combined give us the labor

CHART NO. 13

COMMODITY PROFIT AND LOSS STATEMENT
For 5th Period (Mar. 23 to Apr. 19, 1930)

Bronze Rod Commodity	This Period		Year to Date	
Gross Shipments		13,598.56		52,793.46
Deductions		1,078.91		3,522.44
Net Shipments		12,519.65		49,271.02
Cost of Shipments:				
(1) Metal at Standard	2,381.47		8,405.46	
(2) Conversion at Std.	3,940.68	6,322.15	16,377.41	24,782.87
Gross Profit Above Standard Costs		6,197.50		24,488.15
Percentage of Gross Profit Above Standard Costs		49.50%		49.70%
Variances from Standard Costs:				
(1) On Acct. of Metal	(180.38)		(641.98)	
(2) On Acct. of Convers.	275.31		121.82	
(3) On Acct. of Burden	1,569.23		7,983.20	
(4) On Acct. of Inventory	54.52	1,718.68	335.14	7,798.18
Net Mfg. Profit		4,478.82		16,689.97
Percentage of Net Mfg. Profit		35.77%		33.87%
Commercial Burden		1,855.66		7,819.34
Operating Profit		2,623.16		8,870.63
Non-Operating Burden		(529.26)		(2,248.20)
Net Final Profit		3,152.42		11,118.83
Percentage of Net Profit		25.18%		22.57%
Analysis of Cost of Manufacturing:				
(1) Metal at Standard		2,381.47		8,405.46
(2) Conversion at Standard		3,940.68		16,377.41
(3) Metal Variances		(180.38)		(641.98)
(4) Conversion Variances		275.31		121.82
(5) Burden Variances		1,569.23		7,983.20
(6) Inventory Variances		54.52		335.14
Total Manufacturing Cost		8,040.83		32,581.05

Note: These figures are illustrative and not actual.

cost figures required for our burden statements and profit and loss statements. As we know that all statistics are for equal periods we have a more accurate means of knowing the correct trend for such important matters as sales, production, payrolls, purchases, etc. Our employees like it better; local merchants and banks prefer it; factory foremen acknowledge that all of their statements are more accurate; in brief, we believe that the few inconveniences are much more than counterbalanced by the greater accuracy and the greater convenience entailed.

May I submit this thought for your final consideration? A prominent industrial engineer has made the statement that the old-fashioned accountant is doomed to extinction. Certainly we are

CHART NO. 14

Profit and Loss by Salesmen John Doe & Co.
For the Fiscal Year 1929

Code	Commodity	Net Shipments	Net Profit or Loss	Per-centage
1	Niag Rod	144.40	(124.39)	(86.14)
2	Bronze Rod	3,617.23	146.08	4.04
8	Packless Valves	148.01	14.42	9.74
10	Header Forg. Mach.	34.95	3.32	9.49
16	Press Forg. Mach.	83,645.01	1,037.14	1.24
17	Assemblies	1,795.71	448.88	25.00
20	Dies and Tools	65.72	18.47	28.10
24	Hammer Forg. Only	4,925.28	1,157.62	23.50
25	Sand Castings Only	36.32	11.10	30.56
30	Hammer Forg. Mach.	161.04	39.15	24.31
33	Service Pipe	120.78	59.51	49.27
37	Brass Tubing	12,646.77	882.70	6.98
63	Extruded Shapes	1,800.99	454.36	25.23
64	Refrigerator Parts	1,111.80	411.33	37.00
65	Brass Pipe Fittings	368.17	131.89	35.82
69	Temperature Valves	5.48	2.89	52.74
77	Brass Tubing IPS	1.20	.03	2.50
79	Welding Rod	616.30	24.52	3.98
81	Copper Tube	1,258.47	372.36	29.59
85	Bearing Bronze	1,791.11	726.18	40.53
86	Brass Rod	32.48	2.48	7.64
88	Rod Machined	412.56	(338.72)	(82.10)
90	Sandcastings Mach. and N. P.	48.49	14.01	28.89
93	Brazing Wire	28.41	9.47	33.33
95	Hammer Forg. Mach. and N. P.	40.41	(5.19)	(12.84)
	Totals	114,857.09	5,499.61	4.79
	J. Smith Co. & John Doe & Co.	10,760.78	1,762.72	16.38
	H. B. Brown and John Doe & Co.	876.99	251.64	28.69
		126,494.86	7,513.97	5.94

Note: These figures are illustrative and not actual.

in a period of sudden and sweeping changes. Political systems are changing; social customs are changing; the ideas and methods of a decade ago are obsolete today. Among the problems that press upon our country for solution none is perhaps greater than that of bringing about industrial stabilization. The committee appointed by Mr. Hoover to investigate the causes of waste in industry reported that the loss to mankind as a result of these fluctuations is greater than the losses resulting from war, crime, and disease combined. Mr. Scovell in 1913 in an address before the convention of the National Association of Machine Tool Builders stated for the first time that the amount of burden which can properly be applied to the cost of production in a period of depression should bear the same relation to the normal burden as the existing production bears to the normal production. Today this statement is generally accepted by cost accountants everywhere as self evident and axiomatic. But what can we say of the other multitudinous variations and elusive factors in the cost of industrial production? It is my belief that if cost accountants have the initiative, the intelligence, and above all the courage to apply some of our known tools of scientific inquiry and research to the problems of industrial management we can make a tremendous contribution toward the elimination of waste and the stabilization of the industrial order. If, however, we continue to cling in orthodox fashion to the antiquated rule of thumb methods we may become as Mr. G. Charter Harrison has said—"As extinct as the dinosaur". We cost accountants have not learned enough from the engineers. We have not learned enough of mathematics and of the science of statistics. We know all too little of economies. We can well afford to emulate the methods of the insurance actuaries. If we do some of these things we cannot only render an invaluable service to our respective corporations but we can make cost accounting an exact and applied science. If, however, we do not do these things we are going to find our function usurped by the engineer or the statistician. Economic law is impersonal and relentless. Like the Deity, it is no respecter of persons; it simply operates. Like the seven wise and the seven foolish virgins of Biblical times, there are cost accountants who do and others who do not perceive the signs of the times. It is my sincere hope and wish that this occasion and this discussion may help to advance the

Chart No. 15

1929-1930

FIRST PERIOD

S	M	T	W	T	F	S	
1	2	3	4	5	6	7	D
8	9	10	11	12	13	14	E
15	16	17	18	19	20	21	C
22	23	24	25	26	27	28	

SECOND PEDIOD

S	M	T	W	T	F	S	
Dec.							
29	30	31	1	2	3	4	J
5	6	7	8	9	10	11	A
12	13	14	15	16	17	18	N
19	20	21	22	23	24	25	

THIRD PERIOD

S	M	T	W	T	F	S	
Jan.							
26	27	28	29	30	31	1	F
2	3	4	5	6	7	8	E
9	10	11	12	13	14	15	B
16	17	18	19	20	21	22	

FOURTH PEDIOD

S	M	T	W	T	F	S	
Feb.							
23	24	25	26	27	28	1	M
2	3	4	5	6	7	8	A
9	10	11	12	13	14	15	R
16	17	18	19	20	21	22	

FIFTH PERIOD

S	M	T	W	T	F	S	
Mar.							
23	24	25	26	27	28	29	A
30	31	1	2	3	4	5	P
6	7	8	9	10	11	12	R
13	14	15	16	17	18	19	

SIXTH PERIOD

S	M	T	W	T	F	S	
Apr.							
20	21	22	23	24	25	26	M
27	28	29	30	1	2	3	A
4	5	6	7	8	9	10	Y
11	12	13	14	15	16	17	

SEVENTH PERIOD

S	M	T	W	T	F	S	
May							
18	19	20	21	22	23	24	J
25	26	27	28	29	30	31	U
1	2	3	4	5	6	7	N
8	9	10	11	12	13	14	E

EIGHTH PERIOD

S	M	T	W	T	F	S	
June							
15	16	17	18	19	20	21	J
22	23	24	25	26	27	28	U
29	30	1	2	3	4	5	L
6	7	8	9	10	11	12	Y

NINTH PERIOD

S	M	T	W	T	F	S	
July							
13	14	15	16	17	18	19	A
20	21	22	23	24	25	26	U
27	28	29	30	31	1	2	G
3	4	5	6	7	8	9	

TENTH PERIOD

S	M	T	W	T	F	S	
Aug.							
10	11	12	13	14	15	16	S
17	18	19	20	21	22	23	E
24	25	26	27	28	29	30	P
31	1	2	3	4	5	6	T

ELEVENTH PERIOD

S	M	T	W	T	F	S	
Sept.							
7	8	9	10	11	12	13	O
14	15	16	17	18	19	20	C
21	22	23	24	25	26	27	T
28	29	30	1	2	3	4	

TWELFTH PERIOD

S	M	T	W	T	F	S	
Oct.							
5	6	7	8	9	10	11	N
12	13	14	15	16	17	18	O
19	20	21	22	23	24	25	V
26	27	28	29	30	31	1	

THIRTEENTH PERIOD

S	M	T	W	T	F	S	
Nov.							
2	3	4	5	6	7	8	N
9	10	11	12	13	14	15	O
16	17	18	19	20	21	22	V
23	24	25	26	27	28	29	

FIRST PERIOD

S	M	T	W	T	F	S	
Nov.							
30	1	2	3	4	5	6	D
7	8	9	10	11	12	13	E
14	15	16	17	18	19	20	C
21	22	23	24	25	26	27	

science of cost accounting and may tend to elevate the standards of cost accounting as a profession.

In conclusion may I indulge in a few brief metaphorical digressions. Mr. Henry Ford has stated in his own terse language that there are just three important activities of men, agriculture, manufacturing, and transportation, or *raising* things, *making* things, and *moving* things. Modern society, to him, is like a beautiful flower. The foliage and efflorescence represent the consummation of human achievement in such activities as music, art, philosophy, and literature. All such interests, however, derive their sustenance from roots which are sunk down deep in the dark soil of industry. Our industry, then, is basic and determining in human affairs. Can there be any more important and beneficial task, therefore, than that of shedding light upon such an essential and such a worthy cause?

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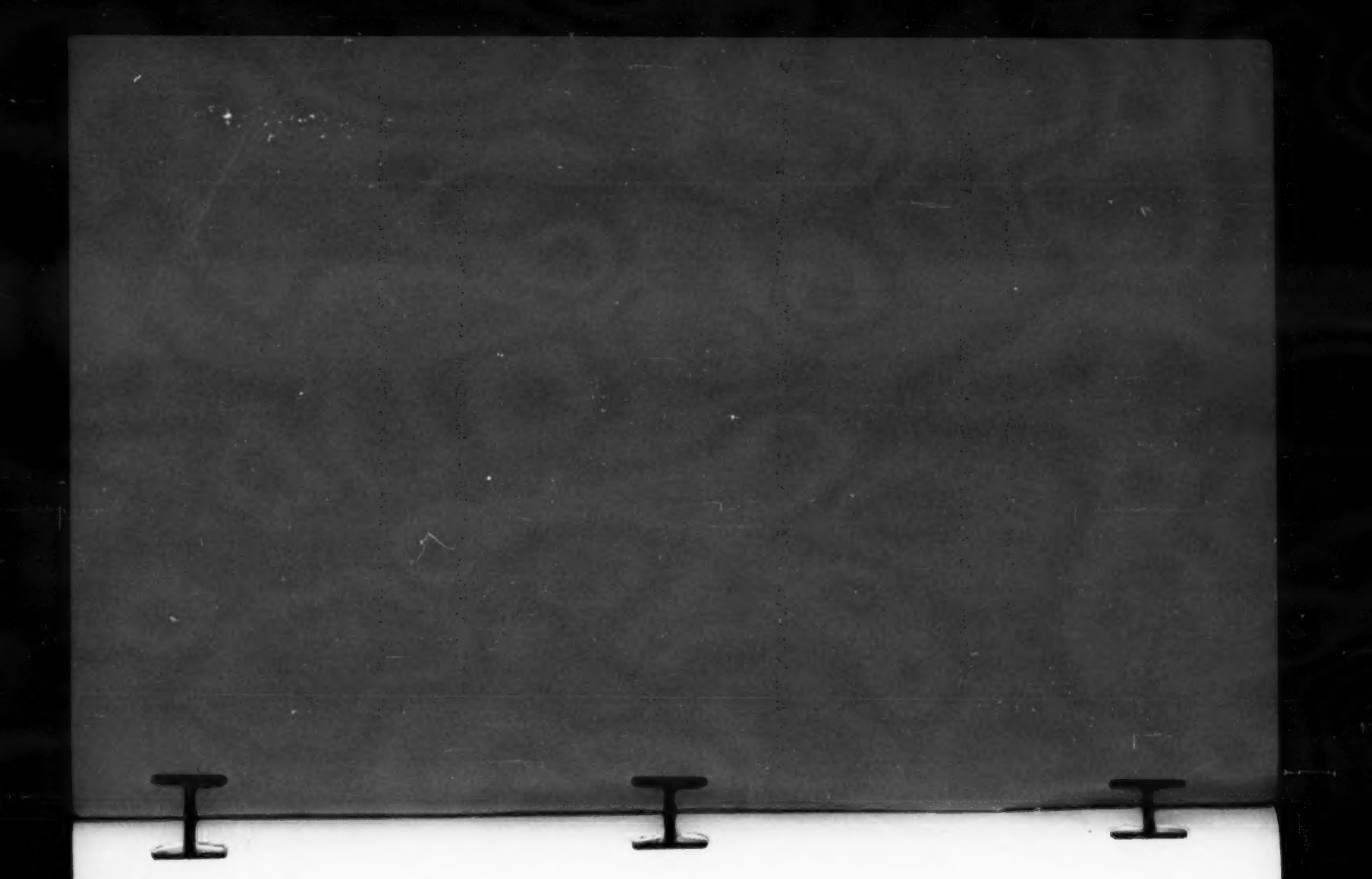

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